XVIII. Biology, Grades 9/10

Grades 9/10 Biology Test

The spring 2006 Grades 9/10 MCAS Biology Test was based on learning standards in the Biology content strand of the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2001). These learning standards appear on pages 49–51 of the *Framework*.

The *Science and Technology/Engineering Curriculum Framework* is available on the Department Web site at www.doe.mass.edu/frameworks/scitech/2001/0501.pdf.

The reporting of results of the Grades 9/10 Biology Test is limited to *Test Item Analysis Reports*. No scaled score or performance level results are available.

Test Sessions

The MCAS Grades 9/10 Biology Test included two separate test sessions. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

The Grades 9/10 Biology Test was designed to be taken without the aid of a calculator. Students were allowed to have calculators with them during testing, but calculators were not needed to answer questions.

The use of bilingual word-to-word dictionaries was allowed for limited English proficient students only, during both test sessions. No other reference tools or materials were allowed.

Cross-Reference Information

The table at the conclusion of this chapter indicates the *Framework* learning standard that each item assesses. The correct answers for multiple-choice questions are also displayed in the table.

Biology
Session 1

DIRECTIONS

This session contains twenty-three multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

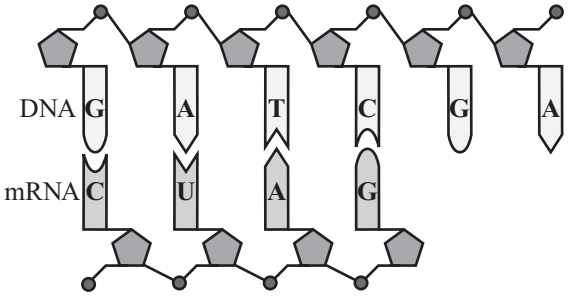
1 A caterpillar eats an oak leaf. Which of the following **best** describes the energy transfer in this situation?

A. Both the caterpillar and the leaf gain energy.
B. Energy is transferred from the leaf to the caterpillar.
C. Decomposers in the leaf obtain energy from the caterpillar.
D. The oak tree gains energy when the caterpillar eats the leaf.

2 The molecule ATP is composed of elements commonly found in organic molecules. Which of the following is one of these elements?

A. aluminum
B. calcium
C. phosphorus
D. tin

3 The diagram below shows a strand of DNA matched to a strand of messenger RNA.



What process does this diagram represent?

A. mutation
B. respiration
C. transcription
D. translation

4 There are two types of modern whales: toothed whales and baleen whales. Baleen whales filter plankton from the water using baleen, plates made of fibrous proteins that grow from the roof of their mouths. The embryos of baleen whales have teeth in their upper jaws. As the embryos develop, the teeth are replaced with baleen.

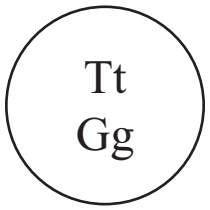
Which of the following conclusions is **best** supported by this information?

A. Primitive whales had teeth as adults.
B. Toothed whales descended from baleen whales.
C. Baleen whales are evolving into toothed whales.
D. Descendants of modern baleen whales will have both teeth and baleen as adults.

5 Which of the following explains why elements, such as carbon and oxygen, that are used in organic molecules are not permanently removed from the environment?

A. They are replenished by sunlight.
B. They are cycled through ecosystems.
C. They are replaced by volcanic eruptions.
D. They are produced constantly from nutrients.

6 The diagram below represents a cell. The letters in the diagram represent alleles for two different genetic traits.



According to Mendel's law of independent assortment, which of the following shows all of the allele combinations expected in gametes produced by this cell?

A. TT tt GG gg

B. TG TG tg tg

C. TG tG Tg tg

D. Tt Tt Gg Gg

7 Some cells, such as human nerve and muscle cells, contain many more mitochondria than do other cells, such as skin cells. Why do some cells have more mitochondria than others?

A. The cells use more energy.

B. The cells store more nutrients.

C. The cells degrade more proteins.

D. The cells divide more frequently.

8 During the fall reproductive season, the belly of a male brook trout becomes bright orange. The orange belly provides some camouflage and helps attract females.

This trait evolved in brook trout because, compared to males with pale bellies, males with bright orange bellies are more likely to

A. live in good habitats.

B. be eaten by predators.

C. mate with other species of fish.

D. fertilize eggs to produce offspring.

9 Which of the following would most likely happen if grasses and shrubs were removed from a rural Massachusetts ecosystem?

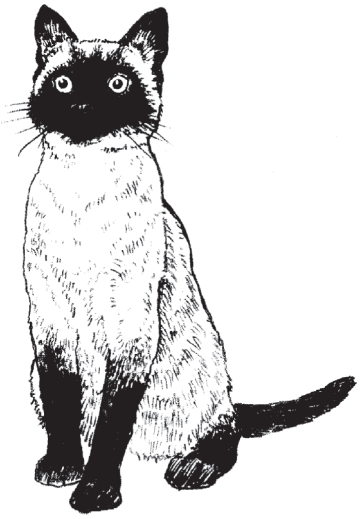
A. There would be an increase in consumers in the ecosystem.

B. There would be an increase of photosynthesis in the ecosystem.

C. There would be a decrease in food energy produced by the ecosystem.

D. There would be a decrease of carbon dioxide available to the ecosystem.

10 The illustration below shows a Siamese cat.



In Siamese cats, an enzyme determines the color of the fur. On the cooler places of the body, the enzyme causes darker fur. On the warmer parts of the body, the enzyme does not function.

Which of the following statements **best** explains how temperature affects this enzyme?

A. Cooler temperatures denature the enzyme.

B. Cooler temperatures cause more enzyme production.

C. The enzyme is active in a specific temperature range.

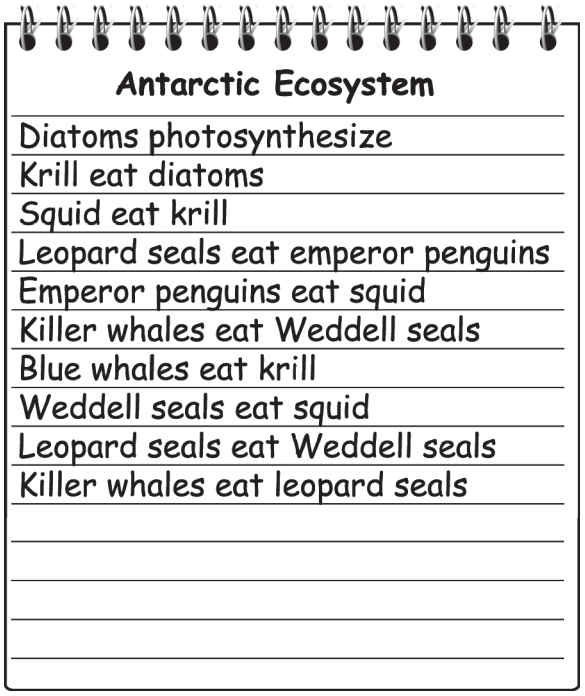
D. Heat allows the enzyme to break down white pigment.

Question 11 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 11 in the space provided in your Student Answer Booklet.

11 A biology student doing research collects the following information about feeding relationships in an Antarctic ecosystem.

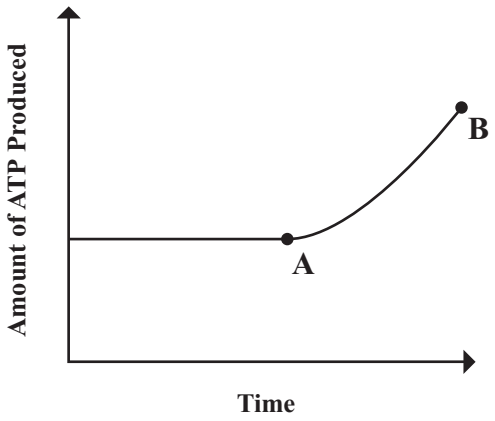


a. Use these notes to construct a food web of this ecosystem in your Student Answer Booklet.

b. In your food web, identify one organism at **each** of the following trophic levels: producer, primary consumer, secondary consumer, and higher-order consumer.

Mark your answers to multiple-choice questions 12 through 24 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

12 The graph below shows the amount of ATP produced in a cell during a period of time.



According to the graph, which of the following processes **must** have increased between points A and B?

A. cellular respiration
B. cytokinesis
C. DNA replication
D. meiosis

13 In one of the steps of the carbon cycle, a person exhales a molecule of carbon dioxide (CO_2) into the atmosphere. Which of the following is **most likely** to happen next to the atom of carbon in this molecule?

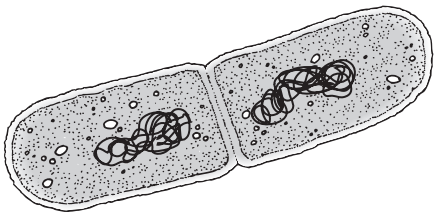
A. It may be used as part of a sugar in a plant.
B. It may become part of a protein in an animal.
C. It may be consumed as a fossil fuel is burned.
D. It may be decomposed into carbon and oxygen by a bacterium.

14 Which of the following is **more likely** to occur in a plant cell than in an animal cell?

A. synthesis of enzymes
B. formation of cellulose
C. breakdown of glucose
D. active transport of ions

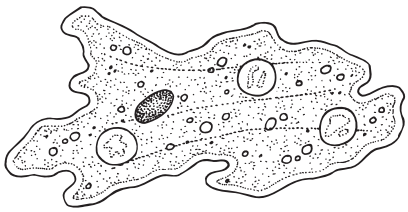
15 Which of the organisms shown below is **not** correctly labeled with its kingdom?

A.



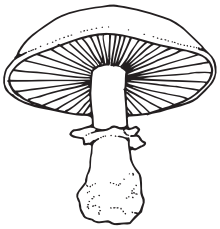
Eubacteria

B.



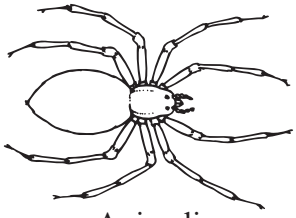
Protista

C.



Plantae

D.



Animalia

16 Which of the following correctly explains how atmospheric nitrogen is converted to nitrogen compounds used by living organisms?

A. Sunlight converts atmospheric nitrogen to a form usable by protists.

B. Plant leaves convert atmospheric nitrogen to a form usable by animals.

C. Bacteria in soil convert atmospheric nitrogen to a form usable by plants.

D. Invertebrate animals in soil convert atmospheric nitrogen to a form usable by fungi.

17 Why is the particular sequence of bases in a segment of DNA important to cells?

A. Some base sequences code for protein production.

B. Some base sequences cause the release of lipids from the nucleus.

C. Some base sequences contain the order of sugars in polysaccharides.

D. Some base sequences produce electrical signals sent to the cytoplasm.

18 A single prokaryotic cell can divide several times in an hour. Few eukaryotic cells can divide as quickly. Which of the following statements **best** explains this difference?

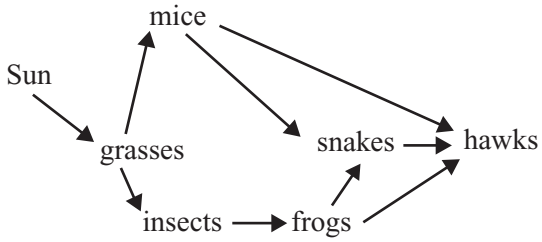
A. Eukaryotic cells are smaller than prokaryotic cells.

B. Eukaryotic cells have less DNA than prokaryotic cells.

C. Eukaryotic cells have more cell walls than prokaryotic cells.

D. Eukaryotic cells are more structurally complex than prokaryotic cells.

19 A food web is shown below.



In this food web, the trophic level with the **least** energy includes which of the following organisms?

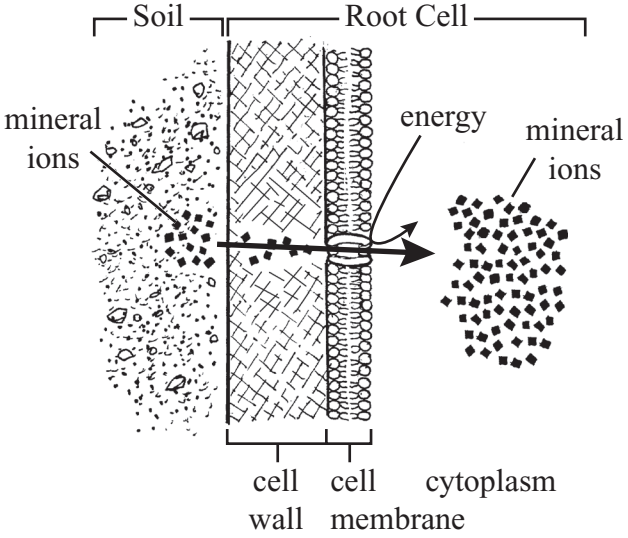
A. grasses

B. mice

C. snakes

D. hawks

20 The diagram below illustrates how plant root cells take in mineral ions from the surrounding soil.



Which of the following processes is illustrated?

A. active transport

B. diffusion

C. osmosis

D. passive filtration

21 Within an individual mouse, four different mutations occurred in different genes, located on separate chromosomes and in different cells, as shown in the table below.

Cell Type	Chromosome	Trait	Normal Phenotype	Mutated Phenotype
skin	chromosome 4	fur color	black fur	white fur
gamete	chromosome 3	eye color	brown eyes	blue eyes
muscle	chromosome 2	fur thickness	thick fur	thin fur
nerve	chromosome 1	tail length	long tail	short tail

Which of these mutations could be passed on to the mouse's offspring?

A. white fur
B. blue eyes
C. thin fur
D. short tail

22 Which of the following is a central role of carbon in the chemistry of living organisms?

A. Carbon can only bond with other carbon atoms.

B. Carbon is a solvent that breaks chemical bonds.

C. Carbon readily forms ionic bonds that separate easily.

D. Carbon can form many types of molecules with covalent bonds.

23 Which of the following occurs during photosynthesis?

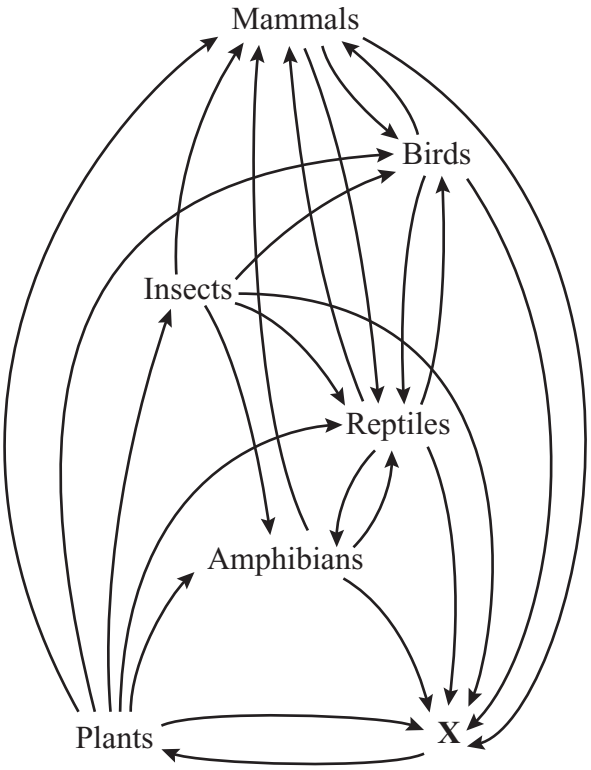
A. CO_2 is used to produce water.

B. CO_2 is absorbed by mitochondria.

C. CO_2 and H_2O are converted to carbohydrates.

D. CO_2 and H_2O are combined into carbonic acid.

24 A food web in a rain forest is shown below.



Which of the following **most likely** occupies the location marked **X** in this food web?

A. decomposers

B. primary consumers

C. producers

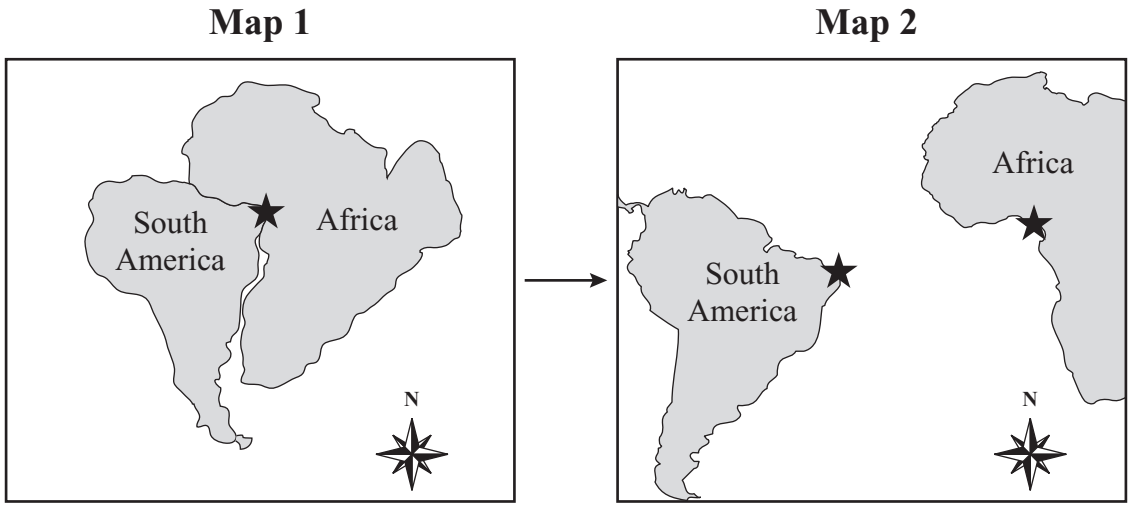
D. secondary consumers

Questions 25 and 26 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 25 in the space provided in your Student Answer Booklet.

25 The maps below show South America and Africa. Areas where fossils of the same extinct plant species have been found are marked with a star.



a. Explain how the widely separated areas marked in Map 2 can have fossils of the same extinct plant species.

In both South America and Africa, there are plants descended from this extinct species. These modern plants are very different from one another.

b. Explain how the extinct species has modern descendants that came to be very different from one another.

Write your answer to question 26 in the space provided in your Student Answer Booklet.

26 In watermelons, solid dark green color (**G**) is dominant to stripes (**g**). A student crosses two watermelon plants that are heterozygous for melon color (**Gg**).

a. In your Student Answer Booklet, make a Punnett square to show this cross. What are the expected percentages of phenotypes of the offspring?

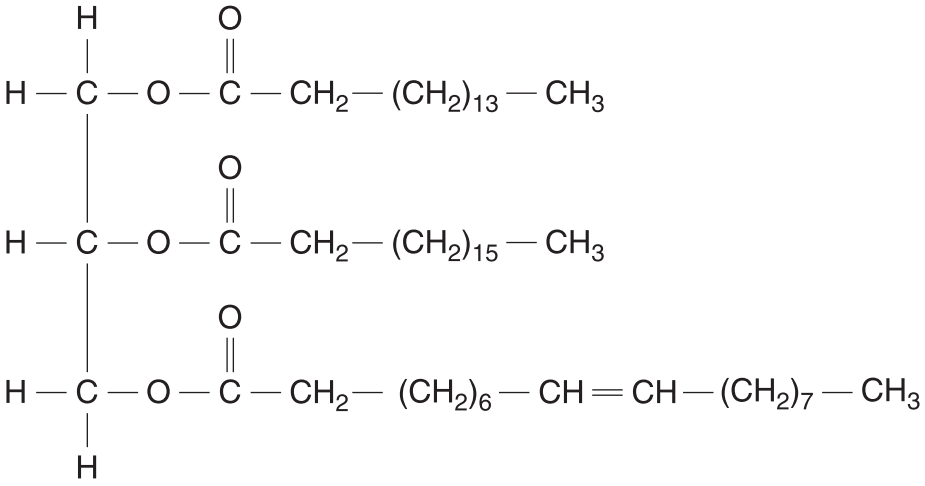
b. The student's cross produces one hundred watermelon plants. Of those 100 plants, 78 plants produce solid dark green watermelons, and 22 produce striped watermelons. Explain these results based on the Punnett square and predictions you made in part (a).

Biology
SESSION 2

DIRECTIONS

This session contains seventeen multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

27 The diagram below represents a fat molecule.



A fat molecule belongs to which category of organic molecules?

A. proteins

B. lipids

C. nucleic acids

D. carbohydrates

28 Human tears contain the enzyme lysozyme, which damages the cell walls of bacteria. Which of the following statements about lysozyme is **most** accurate?

A. Lysozyme causes mutations in bacterial cell wall molecules.

B. Lysozyme is destroyed as it digests bacterial cell wall molecules.

C. Lysozyme breaks a specific type of bond in a bacterial cell wall molecule.

D. Lysozyme is converted to another chemical by a bacterial cell wall molecule.

29 Fertilizers can enable farmers to grow the same crop in a field for several years in a row. Farmers who use less fertilizer often rotate their crops by planting the crop one year and legumes, such as beans and clover, the following year.

Fertilizer use and crop rotation with legumes both increase the availability of which of the following nutrients in soil?

A. calcium

B. nitrogen

C. oxygen

D. protein

30 A rare genetic condition causes dwarfism and immunodeficiencies. Which of the following is the **most likely** cause of this condition?

A. a parasitic infection

B. a mutation in DNA

C. a bacterial disease

D. an excess of ATP

31 All organisms classified in kingdom Animalia must also be classified as which of the following?

A. Archaea

B. Eubacteria

C. Eukaryota

D. Protista

Question 32 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 32 in the space provided in your Student Answer Booklet.

32 In the nucleus of a human cell, RNA polymerase travels along a DNA strand and constructs a new strand of mRNA. The new mRNA strand leaves the nucleus through a pore in the nuclear membrane and enters the cytoplasm. The mRNA associates with a ribosome and a new polypeptide is produced.

Several types of organic molecules are mentioned in the paragraph above.

a. Select **two** different organic molecules mentioned in the paragraph above and classify each as one of the four major types of organic molecules. You may use a table like the one below in your response.

b. Briefly describe the structure and function of **each** organic molecule you identified in part (a). You may use a table like the one below in your response.

Molecule	Classification	Structure	Function

Mark your answers to multiple-choice questions 33 through 38 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

33 Cheetahs have come close to extinction due to hunting, drought, and disease. There is now very little genetic variation in cheetah populations.

Which of the following is a result of the limited genetic variation in the current cheetah populations compared to earlier cheetah populations with more variation?

A. Cheetahs in current populations are more resistant to new diseases.

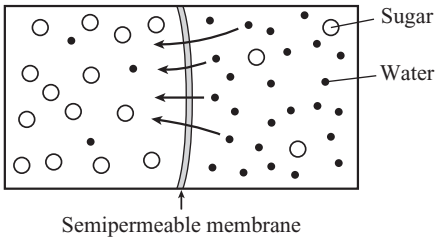
B. The survival rate of young cheetahs is increased in current populations.

C. Cheetahs in current populations are less able to interbreed with other species.

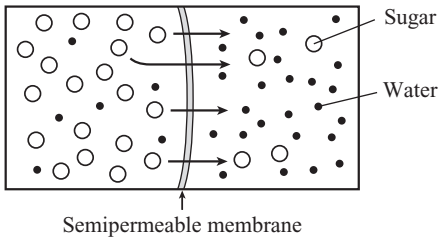
D. The current cheetah populations are less likely to be able to adapt to environmental changes.

34 Which of the diagrams below **best** represents the net movement of molecules in osmosis?

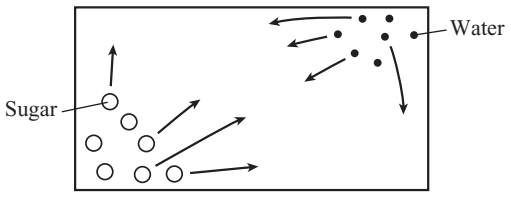
A.



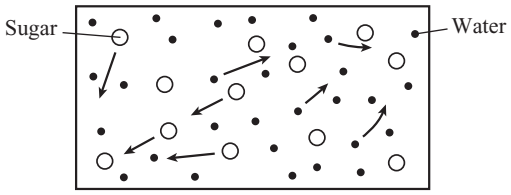
B.



C.



D.



35 Which of the following genetic conditions results from a problem with segregation?

A. **Trisomy 16:** a condition caused when a zygote receives three copies of chromosome 16

B. **Huntington's disease:** a condition caused when a zygote receives a mutated dominant allele

C. **Hemophilia:** a condition caused when a zygote receives an X chromosome with a particular recessive allele

D. **Sickle cell anemia:** a condition caused when a zygote receives a recessive allele for hemoglobin from each parent

36 Two spotted leopards produce a litter of four cubs. Three of the cubs are spotted and one is solid black. The black coat is **probably** what type of trait?

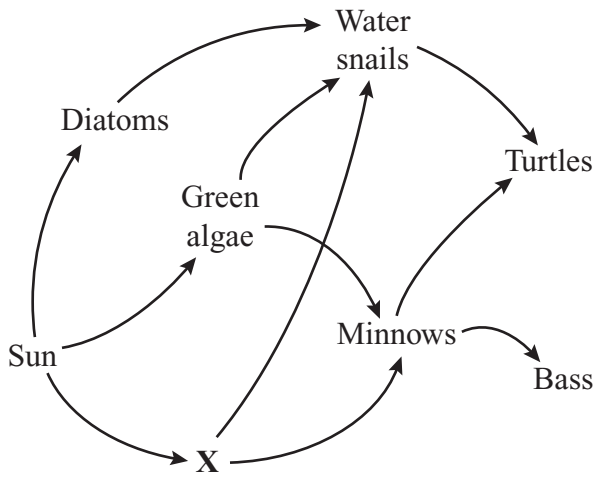
A. dominant

B. recessive

C. polygenic

D. sex-linked

37 A freshwater food web is shown below.



The **X** in this food web **most likely** represents which of the following?

A. dragonfly larvae

B. *Elodea* plants

C. frog eggs

D. *Paramecium* species

38 Which of the following distinguishes the organisms in the kingdom Fungi from other eukaryotic organisms?

A. Fungi are unicellular.

B. Fungi reproduce sexually.

C. Fungi obtain nutrients by absorption.

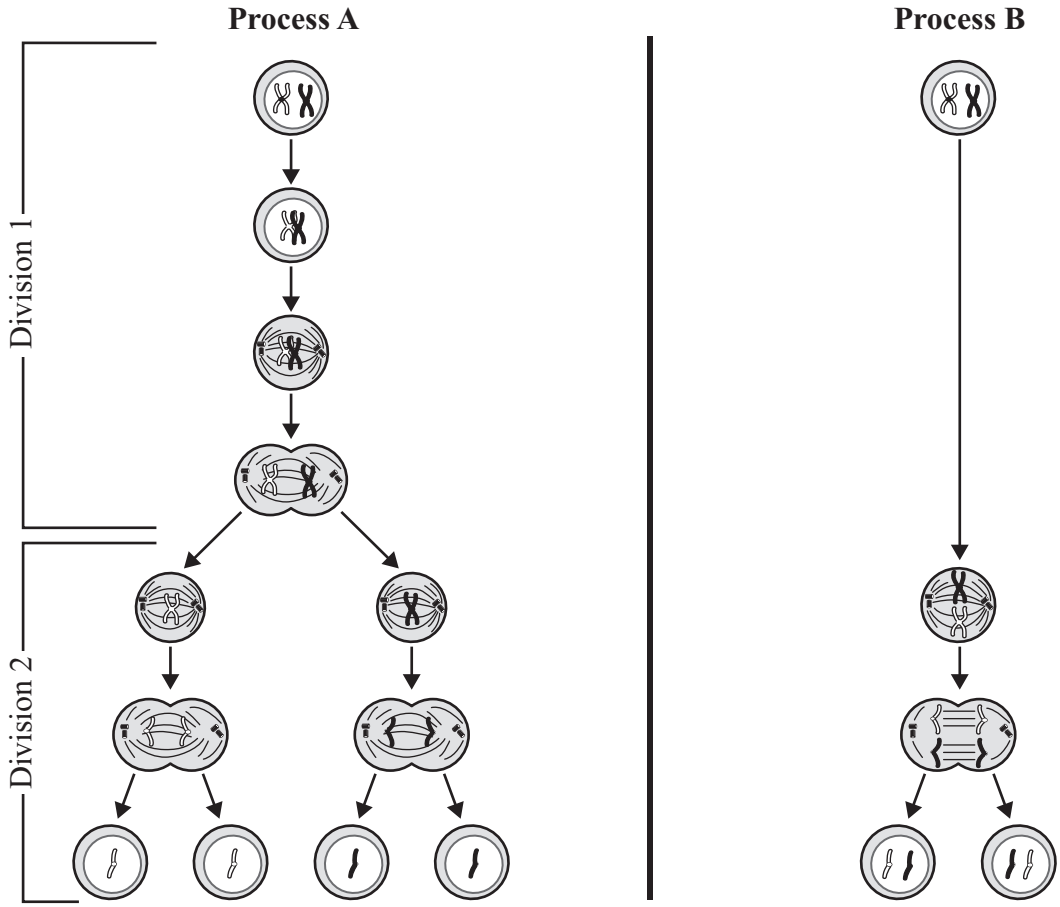
D. Fungi make food through photosynthesis.

Question 39 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 39 in the space provided in your Student Answer Booklet.

39 The diagrams below illustrate two different types of cell division.

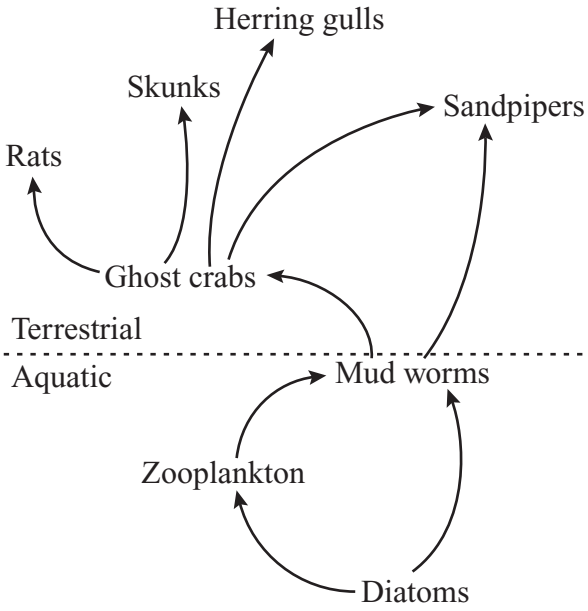


a. Identify which diagram shows the process of mitosis and which diagram shows the process of meiosis.

b. Explain **three** differences between mitosis and meiosis. Your answer should include differences found in the actual processes and differences found in the cells resulting from each type of division.

Mark your answers to multiple-choice questions 40 through 45 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

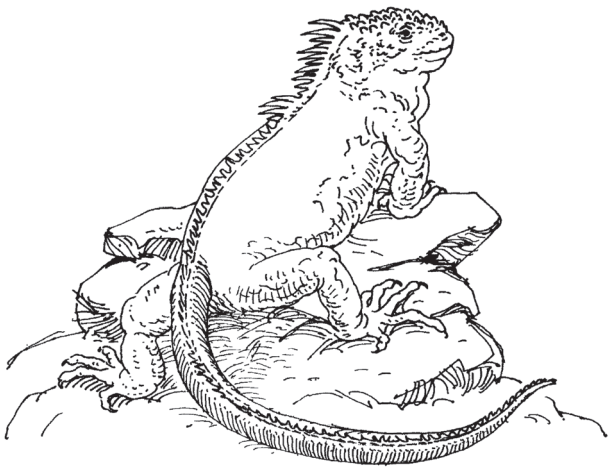
40 A partial food web for a marsh ecosystem is shown below.



The removal of which of the following organisms would **most** reduce the transfer of energy from aquatic organisms to terrestrial organisms?

A. herring gulls
B. sandpipers
C. rats
D. ghost crabs

41 The illustration below represents a marine iguana.



The marine iguanas of the Galápagos Islands feed on seaweed and algae. Marine iguanas have flattened tails while other species of iguanas that live inland on the Galápagos and on the South American mainland have rounded tails.

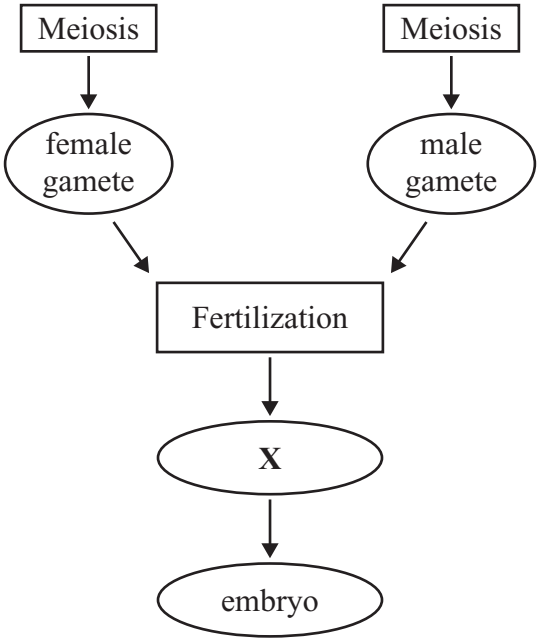
Which of the following **best** explains this difference in tail shape?

A. Flattened tails are better for swimming than rounded tails.
B. Flattened tails move more easily on land than in the ocean.
C. Flattened tails are harder for predators to grasp than rounded tails.
D. Flattened tails release heat more rapidly in the ocean than on land.

42 In which of the following ways are photosynthesis and cellular respiration alike?

A. Both processes produce glucose.
B. Both processes consume carbon dioxide.
C. Both processes take place in chloroplasts.
D. Both processes involve energy transformations.

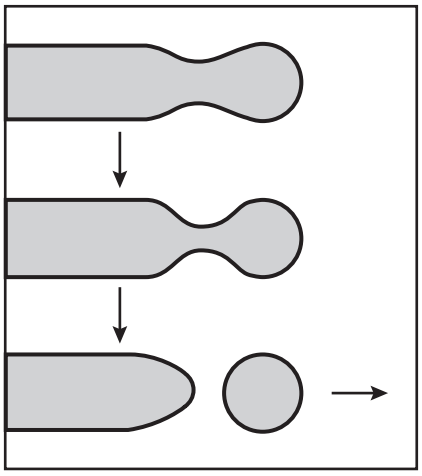
43 A partial diagram of a reproductive process is shown below.



Which of the following labels belongs in the oval marked **X**?

A. egg
B. fetus
C. sperm
D. zygote

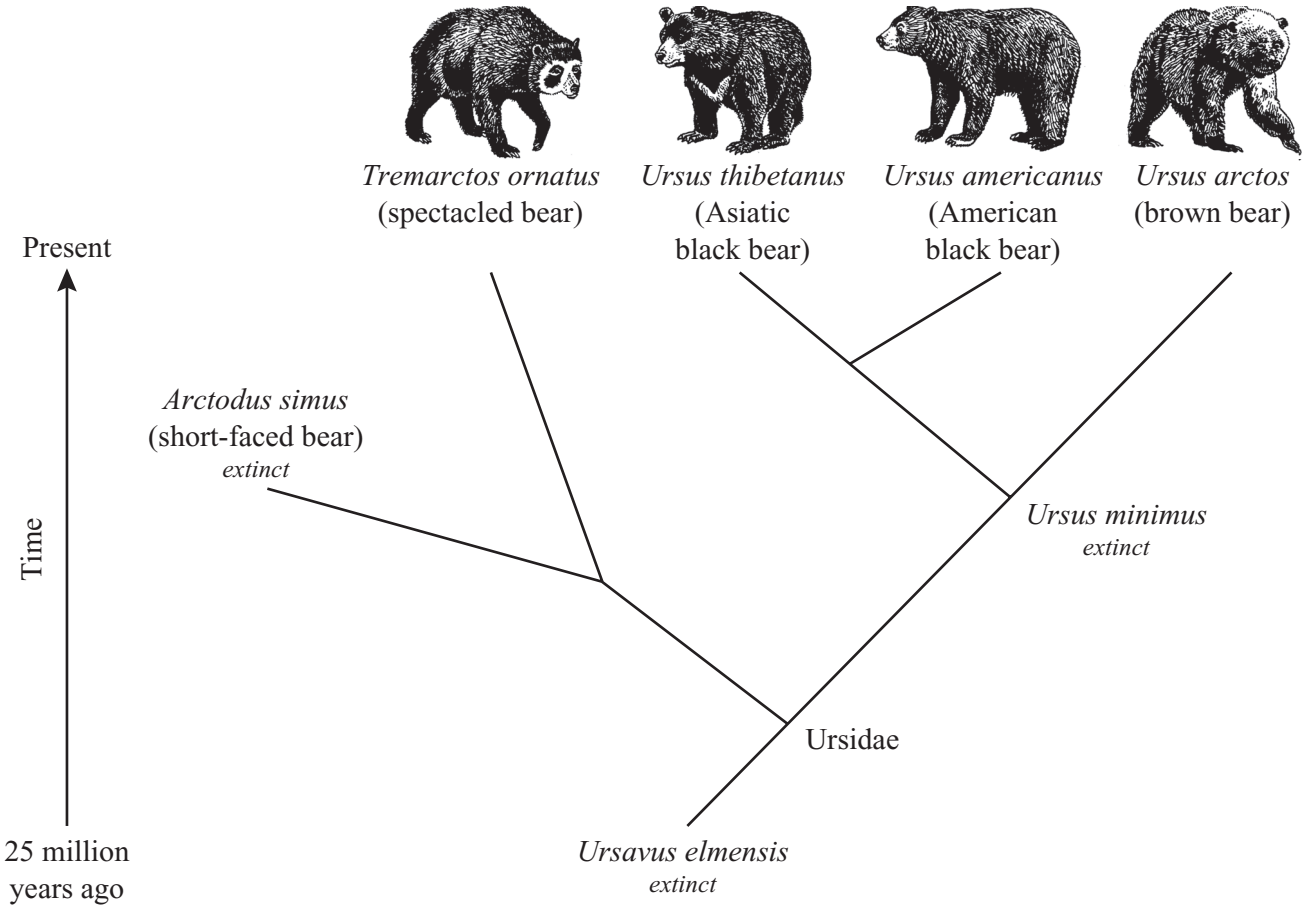
44 A cross section of part of a Golgi complex is shown below.



Part of the membrane of the Golgi complex pinches off and moves away. Which of the following is a function of this process?

A. to release energy from ATP
B. to deliver proteins to other locations in the cell
C. to collect amino acids for use in protein synthesis
D. to send messages about cell requirements to the nucleus

45 A student researching bears found the chart below in a textbook. The chart shows the classifications of several types of bears.



Which of the following conclusions is **best** supported by the data given in this chart?

A. Modern bears evolved from species that are now extinct.

B. The short-faced bear was the ancestor of the Asiatic black bear.

C. Present day bear species are more closely related than their ancestors were.

D. Natural selection favored the brown bear over the American black bear.

Grades 9/10 Biology
Spring 2006 Released Items:
Standards and Correct Answers

Item No.	Page No.	Standard	Correct Answer (MC)*
1	423	2.7	B
2	423	1.2	C
3	423	3.1	C
4	424	5.1	A
5	424	6.1	B
6	424	3.6	C
7	425	2.1	A
8	425	5.2	D
9	425	2.7	C
10	426	1.5	C
11	427	6.2	
12	428	2.8	A
13	428	6.1	A
14	428	2.3	B
15	429	5.3	C
16	429	6.1	C
17	429	3.1	A
18	430	2.2	D
19	430	6.2	D
20	430	2.5	A
21	431	3.4	B
22	432	1.1	D
23	432	2.6	C
24	432	6.2	A
25	433	5.1	
26	434	3.7	
27	435	1.3	B
28	436	1.5	C
29	436	6.1	B
30	436	3.4	B
31	436	5.3	C
32	437	1.3	
33	438	5.2	D
34	438	2.5	A
35	439	3.6	A
36	439	3.5	B
37	439	6.2	B
38	439	5.3	C
39	440	2.10	
40	441	6.2	D
41	441	5.2	A
42	442	2.9	D

Item No.	Page No.	Standard	Correct Answer (MC)*
43	442	3.8	D
44	442	2.1	B
45	443	5.1	A

* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.